DERWENT-ACC-NO: 1996-193884
DERWENT-WEEK: 199620
COPYRIGHT 2000 DERWENT INFORMATION LTD
TITLE: Terminal-point detection method for semiconductor mfr. - by detecting terminal point of polishing based on measured density of implanted impurity ion on oxide film

PRIORITY-DATA:
1994JP-0221007 August 23, 1994

PATENT-FAMILY

PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-IPC
JP 08064561 A	March 8, 1996	N/A	006	H01L021/304

INT-CL (IPC): H01L 21/027; H01L 21/265; H01L 21/304; H01L 21/306

ABSTRACTED-PUB-NO: JP08064561A
BASIC-ABSTRACT:

The method involves implanting ion (14), such as phosphorous ion for terminal-point detection which relates to an oxide film (13) and becomes an impurity, into the oxide film during polishing of the oxide film.

The density of the implanted ion is measured and the terminal point of polishing is detected.

USE/ADVANTAGE - For detecting terminal point of oxide film formed on semiconductor substrate during chemical polishing. Enables brief and accurate detection of terminal point of polishing, irrespective of quality of oxide film to be polished.

L7 ANSWER 17 OF 34 JAPIO COPYRIGHT 2000 JPO
AN 1996-064561 JAPIO
TI **DETECTION** OF END POINT IN CHEMICAL AND MECHANICAL **POLISHING** METHOD AND CHEMICAL AND MECHANICAL **POLISHING** DEVICE

IN ITANI NAOKI
PA NIPPON STEEL CORP, JP [CO 000665]
PI JP 08064561 A 19960308 Heisei
AI JP1994-221007 (JP06221007 Heisei) 19940823
SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 96, No. 3
AB PURPOSE: To **detect** the end point of a chemical and mechanical **polishing** simply and accurately regardless of the film quality of a film to be **polished**, without increasing significantly the number of processes and moreover, without needing a **polishing** device of a special structure.
CONSTITUTION: Wirings 12 are formed on a semiconductor substrate 11 and thereafter, an oxide film 13 is formed on the substrate 11 as an inter-layer insulating film and after this, end point **detection** ions 14, such as phosphorus ions, which are used as impurities in regard to the film 13, are **implanted** in the film 13. The substrate 11 is set on a **polishing** device 15 in such a way that the film 13 is faced downward and the film 13 is **polished** chemically and mechanically while an abrasive liquid 16 is fed on the surface of the device 15. When the **polishing** of the film 13 proceeds and reaches the **implanted** region of the ions 14, the ions 14 come out being contained in the abrasive liquid 16 along with the component of the **polished** film 13. By measuring the concentration of the ions 14 in the liquid 16 by an ion concentration measuring device 19, the end point of the **polishing** is **detected**.

L1 ANSWER 1 OF 1 CA COPYRIGHT 2000 ACS
AN 124:330151 CA
TI Determination of termination of chemical and mechanical etching of semiconductor films
IN Itani, Naoki
PA Shinnippon Seitetsu Kk, Japan
SO Jpn. Kokai Tokkyo Koho, 6 pp.
CODEN: JKXXAF
DT Patent
LA Japanese
IC ICM H01L021-304
ICS H01L021-265; H01L021-027; H01L021-306
CC 76-3 (Electric Phenomena)
FAN.CNT 1

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 08064561	A2	19960308	JP 1994-221007	19940823

AB Impurity ions (e.g., P) are implanted in the films and the concn. of the ions appearing in the etchant solns. are detd. during the etching.
ST chem mech polishing semiconductor film; phosphorus ion implantation semiconductor film etching
IT Etching
Semiconductor materials
(ion implantation in detn. of termination of chem. and mech. etching of
semiconductor films)
IT 7723-14-0, Phosphorus, uses
RL: MOA (Modifier or additive use); USES (Uses)

L2 ANSWER 1 OF 1 [redacted] JAPIO COPYRIGHT 1999 JPO
AN 1998-242089 JAPIO
TI POLISHING END POINT DETECTING METHOD, POLISHING EQUIPMENT AND SEMICONDUCTOR DEVICE
IN YAMAMURO TAKASHI
PA MITSUBISHI ELECTRIC CORP, JP (CO 000601)
RYODEN SEMICONDUCTOR SYST ENG KK, JP (CO)
PI JP10242089 A 19980911 Heisei
AI JP1997-39317 (JP09039317 Heisei) 19970224
SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 98, No. 9
AB PURPOSE: TO BE SOLVED:To provide a polishing end point detecting method which easily and precisely detects the end point of polishing. CONSTITUTION: -difference is generated on a polysilazane film 33 and an insulating film 34 which are deposited in order and formed on a metal wiring 32, and flattening is necessary. For flattening, a wafer 3 is polished from the side of the insulating film 34, by using abrasive agent containing solvent having hydroxyl groups. When polishing is progressed, the surface of the wafer 13 is flattened, and the surface of the polysilazane film 34 is partly exposed at last. Then ammonia gas is generated by chemical reaction of the solvent and the polysilazane film 33. The generated ammonia gas is detected by a detector, and the gas generation is set as the reference for the end point of polishing.

Entry 4 of 62 File: DWPI Sep 11, 1998

DERWENT-ACC-NO: 1998-548297
DERWENT-WEEK: 199847
COPYRIGHT 1999 DERWENT INFORMATION LTD
TITLE: Polish end point detection method for semiconductor wafer - involves indicating end point of polishing by generation of ammonia gas due to reaction of first film of processed object with predetermined solvent

PRIORITY-DATA:
1997JP-0039317 February 24, 1997

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-IPC
JP 10242089 A	September 11, 1998	N/A	005	H01L021/304

INT-CL (IPC): B24 B 1/00; B24 B 37/04; H01 L 21/304

ABSTRACTED-PUB-NO: JP10242089A
BASIC-ABSTRACT:

The method involves making the first film (33) of a processed object (13) contact a predetermined solvent. Before establishing the contact, the first film which is formed in order with a second film (34), is exposed.

By the reaction of the first film with the solvent, ammonia gas is generated. The generation of ammonia gas is detected by a detector and understood as the standard of polishing end point.

USE - For semiconductor device manufacture.

ADVANTAGE - Avoids too much polishing. Detects gas generation reliably.

(19)日本国特許庁（ＪＰ）　(12)**公開特許公報（Ａ）**　(11)特許出願公開番号

特開平8－64561

(43)公開日　平成８年(1996)３月８日

(51)Int.Cl.[6]	識別記号	庁内整理番号	Ｆ Ｉ	技術表示箇所
Ｈ０１Ｌ　21/304	３２１　Ｅ			
	Ｓ			
21/265				
			Ｈ０１Ｌ　21/ 265	Ｗ
			21/ 30	５６９　Ｇ

審査請求　未請求　請求項の数２　ＦＤ　（全　６　頁）　最終頁に続く

(21)出願番号　特願平6－221007

(22)出願日　平成６年(1994)８月23日

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東京都千代田区大手町２－６－３　新日本製鐵株式会社内

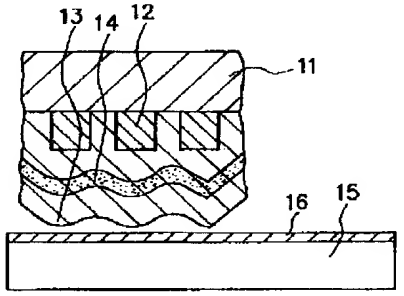
(74)代理人　弁理士　國分　孝悦

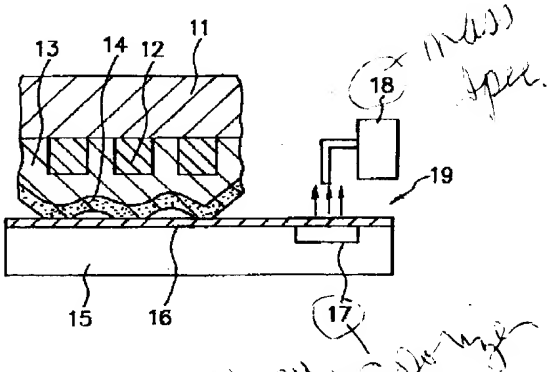
(54)【発明の名称】　化学的機械的研磨法における終点検出方法及び化学的機械的研磨装置

(57)【要約】

【目的】　研磨すべき膜の膜質にかかわらず、また、工程数を大幅に増加させることなく、しかも、特殊な構造の研磨装置を必要とせずに、化学的機械的研磨の終点を簡単かつ正確に検出する。

【構成】　半導体基板１１上に配線１２を形成した後、層間絶縁膜として酸化膜１３を形成し、この後、酸化膜１３に関して不純物となる終点検出用イオン１４、例えばリンイオンを酸化膜１３中に打ち込む。半導体基板１１をその酸化膜１３が下向きになるように研磨装置１５にセットし、研磨液１６を供給しながら酸化膜１３を化学的機械的に研磨する。酸化膜１３の研磨が進行してイオン１４の注入域に到達すると、研磨液１６の中には研磨された酸化膜１３の成分と共にイオン１４が含まれて出てくる。研磨液１６中のイオン１４の濃度をイオン濃度測定装置１９により測定することによって、研磨の終点を検出する。





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【特許請求の範囲】

【請求項１】　半導体基板上に形成された膜を化学的機械的に研磨する際の終点を検出する方法であって、

予め前記膜中にその膜成分に関して不純物となる終点検出用イオンを注入し、研磨液を用いての前記膜の研磨時に研磨液中に含出する前記イオンの濃度を測定することにより、研磨の終点を検出することを特徴とする化学的機械的研磨法における終点検出方法。

【請求項２】　基板ホルダに保持された半導体基板の表面を回転テーブル上に設けられた研磨パッドに接触させて研磨液を供給しつつ、前記半導体基板上に形成された膜を化学的機械的に研磨する装置であって、

予め終点検出用イオンが注入された前記膜の研磨時に研磨液中に含出する前記イオンの濃度を測定するイオン濃度測定手段を備えたことを特徴とする化学的機械的研磨装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、半導体装置の製造工程において、半導体基板上に形成された膜を化学的機械的に研磨する際に、その研磨の終点を検出する方法、及びこの方法を用いるのに好適な化学的機械的研磨装置に関する。

【０００２】

【従来の技術】半導体装置の製造工程においては、例えば半導体基板上に形成された配線を覆う絶縁膜の表面等、様々な種類及び位置の膜層の表面に対する平坦化がしばしば行われており、この平坦化技術の一つとして化学的機械的研磨がある。この化学的機械的研磨は、基板ホルダに保持された半導体基板の表面を回転テーブル上に設けられた研磨パッドに接触させて研磨液を供給しつつ、研磨液と研磨パッドとの協働作用によって、半導体基板上に形成された膜を化学的機械的に研磨するものである。そして、この化学的機械的研磨においては、研磨すべき膜の下層の膜を除去することなく、所定の膜厚で平坦な表面を形成するために、研磨の終点を確実に検出することが極めて重要である。

【０００３】例えば、図５（ａ）に示すように、半導体基板３１上に配線３２を形成した後、図５（ｂ）に示すように、層間絶縁膜である酸化膜３３を形成し、この後、図５（ｃ）に示すように、酸化膜３３の化学的機械的研磨を行う。このとき、従来は一般的に、酸化膜３３の研磨開始からの研磨時間によって、研磨の終点を検出している。

【０００４】また、特開平５－２２６３３４号公報においては、図６（ａ）に示すように、半導体基板３１上に配線３２を形成した後、図６（ｂ）に示すように、半導体基板３１上に後の層間絶縁膜よりも堅い膜、即ち窒化シリコン膜３４を配線３２よりも高く形成し、この後、図６（ｃ）に示すように、層間絶縁膜である酸化膜３３

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を形成して、この酸化膜３３の化学的機械的研磨を行う。このとき、図６（ｄ）に示すように、研磨装置の研磨パッド３５が窒化シリコン膜３４に接触すると、研磨速度が酸化膜３３の研磨時よりも遅くなることによって、研磨の終点を検出している。

【０００５】さらに、特開平４－３５７８５１号公報においては、化学的機械的研磨装置における回転テーブルや基板ホルダ等を電極構造にすると共に電気計測システムを設けて、導電性基板上の誘電体層の厚さを容量的に測定することによって、研磨の終点を検出している。

【０００６】

【発明が解決しようとする課題】しかしながら、図５で説明した従来例のように、研磨時間によって酸化膜３３の研磨の終点を検出するものは、研磨する酸化膜３３の膜質が異なる毎に、条件設定が必要となる欠点があった。

【０００７】また、図６で説明した特開平５－２２６３３４号公報記載のように、終点検出用の窒化シリコン膜３４の柱を形成するものは、成膜、フォトリソグラフィ、エッチング、アッシング等の工程が必要となり、工程数が大幅に増加するという欠点があった。

【０００８】さらに、前述した特開平４－３５７８５１号公報記載のように、導電性基板上の誘電体層の厚さを容量的に測定するものは、研磨装置における回転テーブルや基板ホルダ等を電極構造にすると共に電気計測システムを設けるので、特殊な構造の研磨装置が必要になるという問題があった。

【０００９】そこで本発明は、研磨すべき膜の膜質にかかわらず、また、工程数を大幅に増加させることなく、しかも、特殊な構造の研磨装置を必要とせずに、化学的機械的研磨の終点を簡単かつ正確に検出することが可能な方法及び化学的機械的研磨装置を提供することを目的とする。

【００１０】

【課題を解決するための手段】上記課題を解決するために、本発明は、半導体基板上に形成された膜を化学的機械的に研磨する際の終点を検出する方法であって、予め前記膜中にその膜成分に関して不純物となる終点検出用イオンを注入し、研磨液を用いての前記膜の研磨時に研磨液中に含出する前記イオンの濃度を測定することにより、研磨の終点を検出するものである。

【００１１】また、本発明は、基板ホルダに保持された半導体基板の表面を回転テーブル上に設けられた研磨パッドに接触させて研磨液を供給しつつ、前記半導体基板上に形成された膜を化学的機械的に研磨する装置であって、予め終点検出用イオンが注入された前記膜の研磨時に研磨液中に含出する前記イオンの濃度を測定するイオン濃度測定手段を備えたものである。

【００１２】

【作用】上記のように構成された本発明によれば、研磨

すべき膜中に予め終点検出用イオンを注入するので、研磨液を用いての膜の研磨がイオンの分布域に到達すると、研磨液中には研磨された膜の成分と共にイオンが含まれて出てくることになる。この研磨液中のイオンの濃度を測定することによって、研磨の終点を極めて簡単かつ正確に検出することができる。

【００１３】これによって、研磨の終点は膜質によることなく、その場観察で検出を行うことが可能になる。また、終点検出用の窒化シリコン膜の柱を形成する場合のような成膜、フォトリソグラフィ、エッチング、アッシング等の工程が不要のため、工程数が大幅に増加することはない。さらに、半導体基板の電気的特性等を測定するものではないので、研磨装置の本体は何ら特殊な構造を必要としない。しかも、イオンを注入する際のエネルギーを制御することにより、膜中のイオン分布深さを変えることができるため、自由に終点の位置を設定することが可能である。

【００１４】

【実施例】以下、本発明による化学的機械的研磨法における終点検出方法及び化学的機械的研磨装置の実施例について図１～図４を参照して説明する。

【００１５】まず、図２（ａ）に示すように、半導体基板１１上に配線１２を形成した後、図２（ｂ）に示すように、配線１２と更にその上に形成される配線とを絶縁するための層間絶縁膜として酸化膜１３を形成する。次に、図２（ｃ）に示すように、酸化膜１３に関して不純物となる終点検出用イオン１４、例えばリンイオンを酸化膜１３中に打ち込む。このとき、イオン１４の打ち込まれる深さは、打ち込み時のエネルギーにより制御することができる。

【００１６】次に、図１（ａ）に示すように、半導体基板１１をその酸化膜１３が下向きになるように化学的機械的研磨装置１５にセットし、研磨液１６を供給しながら酸化膜１３を化学的機械的に研磨する。

【００１７】図１（ｂ）に示すように、酸化膜１３の研磨が進行してイオン１４の注入域に到達すると、研磨液１６の中には研磨された酸化膜１３の成分と共にイオン１４が含まれて出てくる。そこで、研磨液１６中のイオン１４の濃度をイオン濃度測定装置１９によって測定し、これによって、研磨の終点を極めて簡単かつ正確に検出することができる。なお、本実施例におけるイオン濃度測定装置１９は、研磨中の研磨液１６を加熱して蒸発させる抵抗ヒーター１７と、蒸発させた雰囲気中のイオン１４の濃度を計測する質量分析器１８とによって構成されている。

【００１８】図３に示すのは、化学的機械的研磨装置１５の平面図を表したものである。化学的機械的研磨装置１５の周縁部に抵抗ヒーター１７を設けている。周縁部に抵抗ヒーター１７を設けるため、研磨液１６を安定して蒸発させることが可能となる。抵抗ヒーター１７の加熱により研磨液１６を化学的機械的研磨装置１５上で蒸発させ、この蒸発したイオンを直接質量分析器１８で計測できるので、タイムラグが少なく計測が行える。そのため、正確な研磨が行える。なお、図３に示すように抵抗ヒーター１７を局部的に設けてもよいし、また場合によっては、化学的機械的研磨装置１５の全体に設けてもよい。

【００１９】上述した本実施例の終点検出方法を用いて化学的機械的研磨を行う場合、研磨装置１５の本体は何ら特殊な構造を必要としない。即ち、研磨のために供給された研磨液１６を研磨の進行に伴ってイオン濃度測定装置１９によって測定すればよいので、このイオン濃度測定装置１９は研磨装置１５の本体と別体に設けてもよい。また、終点検出用イオン１４の注入は、半導体装置の製造工程で多用されるイオン注入装置を利用することができるので、本実施例の方法を適用するに際して特別な装置設備は必要ない。

【００２０】なお、上述したように、研磨装置１５の本体は何ら特殊な構造を必要としないのであるが、以下に、イオン濃度測定装置１９を備えた研磨装置１５の好適な実施例を図４を参照して説明する。

【００２１】即ち、研磨装置１５は、回転テーブル２１と基板ホルダ２２とを有し、回転テーブル２１上に研磨パッド２３が装着されている。基板ホルダ２２に半導体基板１１を酸化膜１３が下向きになるように保持させ、酸化膜１３の表面を研磨パッド２３に密着させる。そして、回転テーブル２１を軸２１ａを中心に回転させると共に、基板ホルダ２２自体も軸２２ａを中心に回転させ、供給ノズル２４により研磨液１６を研磨パッド２３上に供給しながら、研磨液１６と研磨パッド２３との協働作用によって酸化膜１３を研磨する。

【００２２】上記の研磨装置１５において、新しい研磨液１６は回転テーブル２１の中心近傍で研磨パッド２３上に供給され、研磨の進行に伴って酸化膜１３の成分を含む研磨液１６は回転テーブル２１の回転遠心力によって外周部へ流れる。そこで、図４（ａ）に示すように、回転テーブル２１の外周部の下方に容器２５を設置し、回転テーブル２１から流れ落ちる研磨液１６を容器２５によって採取し、この研磨液１６をイオン濃度測定装置１９によって測定する。この例では、落下する研磨液１６を採取するので、採取のための構造が簡単になる。或いは、図４（ｂ）に示すように、基板ホルダ２２の外側近傍で研磨パッド２３上に吸引ノズル２６を延設し、研磨パッド２３上の研磨液１６を吸引ノズル２６によって採取し、この研磨液１６をイオン濃度測定装置１９によって測定してもよい。この例では、特に研磨に作用した直後の研磨液１６を測定することができるので、終点検出精度をより向上させることができる。

【００２３】以上、本発明の実施例について説明したが、本発明は上記実施例に限定されることなく、本発明

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の技術的思想に基づいて各種の有効な変更並びに応用が可能である。例えば、研磨する膜は、配線間の絶縁膜としての酸化膜以外に、各層における各種の膜でよく、膜中に注入する終点検出用イオンも、その膜に応じた各種のイオンを適用可能である。また、イオン濃度測定手段も、各種の測定装置を採用することができる。

【００２４】

【発明の効果】以上説明したように、本発明によれば、研磨すべき膜中に予め終点検出用イオンを打ち込み、その膜の研磨に伴って研磨液中に含出するイオンの濃度を測定することによって、研磨する膜の膜質にかかわらず、また、工程数を大幅に増加させることなく、しかも、特殊な構造の研磨装置を必要とせずに、さらに、終点の位置を自由に設定した状態で、化学的機械的研磨の終点を極めて簡単かつ正確に検出することが可能になり、半導体装置における高集積化の促進並びに信頼性の向上を図ることができる。

【図面の簡単な説明】

【図１】本発明の実施例における終点検出方法及び研磨装置を説明する半導体装置及び研磨装置の概略断面図である。

【図２】上記実施例において研磨される半導体装置の概略断面図である。

【図３】上記実施例における研磨装置の概略平面図である。

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【図４】本発明の好適な実施例における研磨装置の概略断面図である。

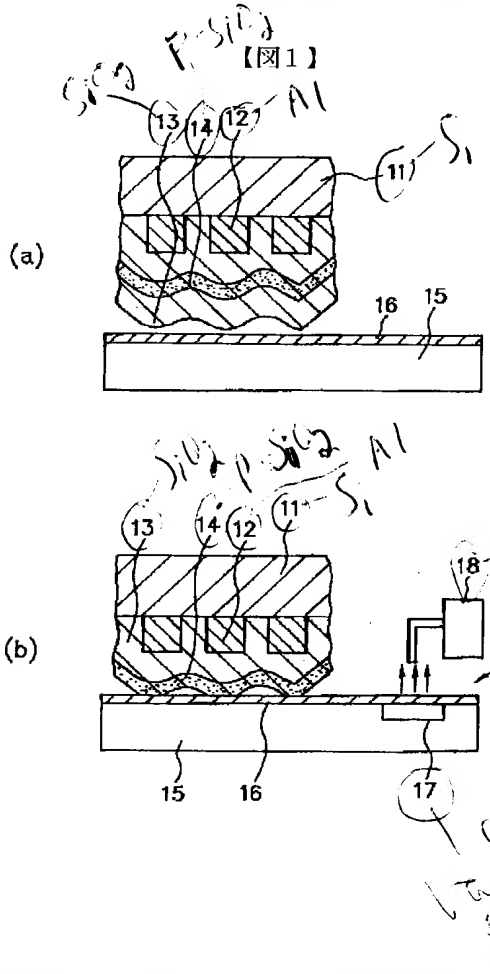
【図５】従来の一般的な終点検出方法を説明する半導体装置の概略断面図である。

【図６】従来の終点検出用の膜を用いた終点検出方法を説明する半導体装置の概略断面図である。

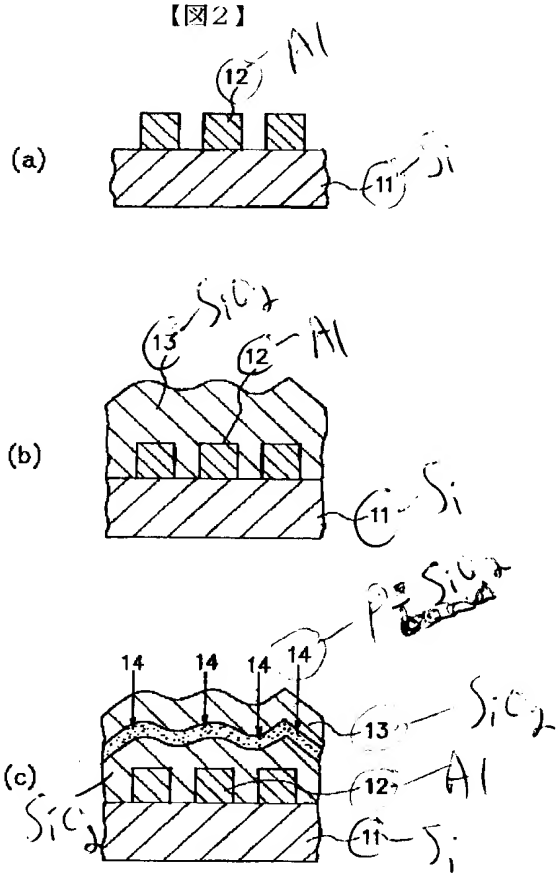
【符号の説明】

１１　半導体基板
１２　配線
１３　層間絶縁膜である酸化膜
１４　終点検出用イオン
１５　化学的機械的研磨装置
１６　研磨液
１７　抵抗ヒーター
１８　質量分析器
１９　イオン濃度測定装置
２１　回転テーブル
２２　基板ホルダ
２３　研磨パッド
２４　研磨液供給用ノズル
２５　研磨液採取用容器
２６　研磨液吸引用ノズル

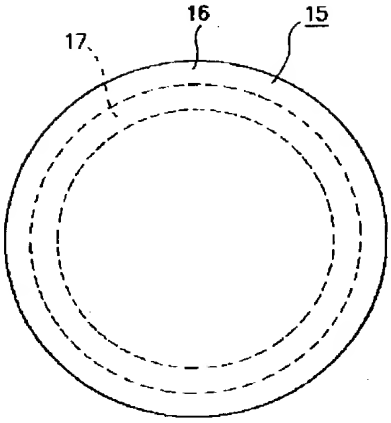
【図１】



【図２】



【図3】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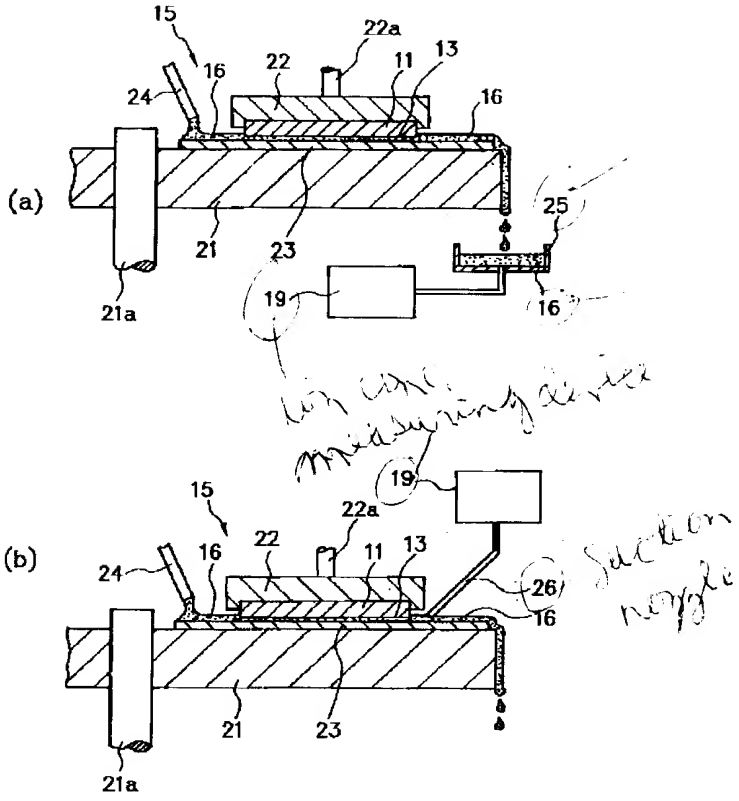
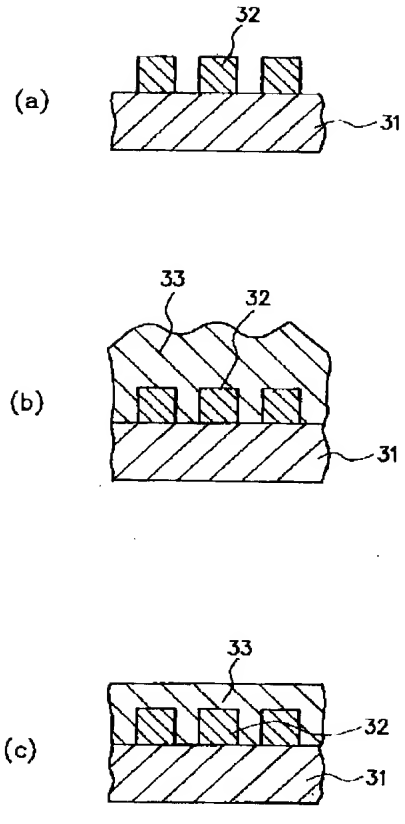
15
17

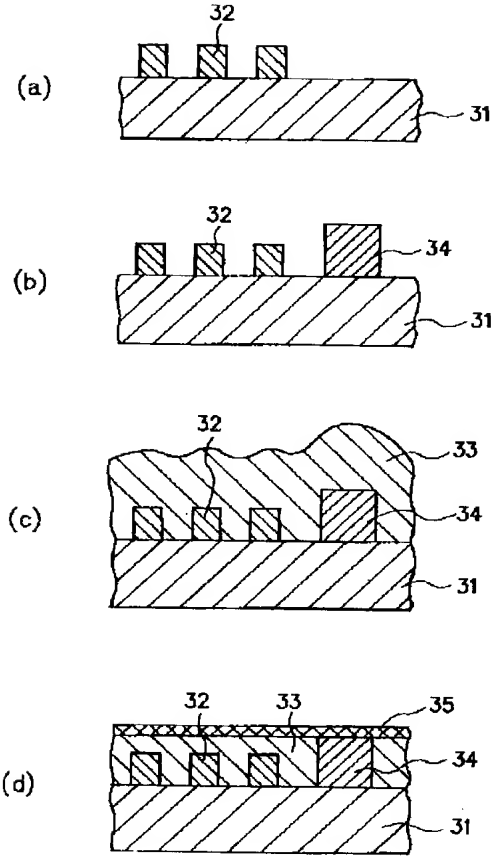
【図4】


(a)
15
22a
22
11
13
16
24
16
25
21
23
21a
19
16
(b)
19
15
22a
22
16
11
13
24
26
16
21
23
21a

【図5】



【図6】



フロントページの続き

(51)Int.Cl.⁶	識別記号	庁内整理番号	F I	技術表示箇所
H01L 21/027 21/306				
			H01L 21/306	U

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08-064,561

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CLAIMS

[Claim(s)]
[Claim 1] The terminal-point method of detection in the chemical mechanical grinding method which is the technique of detecting the terminal point at the time of grinding chemically mechanically the layer formed on the semiconductor substrate, and is characterized by to detect the terminal point of polishing by measuring the concentration of the aforementioned ion which pours in the ion for a terminal-point detection which serves as an impurity about the membrane component into the aforementioned layer beforehand, and ****s in polishing liquid at the time of polishing of the aforementioned layer using polishing liquid.
[Claim 2] The chemical mechanical polishing equipment which is the equipment which grinds chemically mechanically the layer formed on the aforementioned semiconductor substrate, making the polishing pad in which the front face of the semiconductor substrate held at the substrate electrode holder was established on the rotary table contact, and supplying polishing liquid, and carries out [having had an ion-concentration measurement means measure the concentration of the aforementioned ion which ****s in polishing liquid, at the time of polishing of the aforementioned layer with which the ion for a terminal-point detection was poured in beforehand, and] as the characteristic feature

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] In the manufacturing process of a semiconductor device, in case this invention grinds chemically mechanically the layer formed on the semiconductor substrate, it relates to the method of detecting the terminal point of the polishing, and suitable chemical mechanical polishing equipment to use this technique.
[0002]
[Description of the Prior Art] In the manufacturing process of a semiconductor device, various modalities, such as a front face of a wrap insulator layer, and the flattening to the front face of the membrane layer of a position are often performed in the wiring formed, for example on the semiconductor substrate, and there is chemical mechanical polishing as one of these flattening techniques. It grinds chemically mechanically the layer formed on the semiconductor substrate by collaboration operation with polishing liquid and a polishing pad, contacting this chemical mechanical polishing to the polishing pad in which the front face of the semiconductor substrate held at the substrate electrode holder was established on the rotary table, and supplying polishing liquid. And in this chemical mechanical polishing, in order to form a flat front face by the predetermined thickness, without removing the layer of a lower layer of the layer which should be ground, it is very important to detect the terminal point of polishing certainly.
[0003] For example, as shown in drawing 5 (b), the oxide film 33 which is a layer insulation layer is formed, and as shown in drawing 5 (a), after forming wiring 32 on the semiconductor substrate 31, as shown in drawing 5 (c) after this, chemical mechanical polishing of an oxide film 33 is performed. Generally at this time, the polishing time from polishing start of an oxide film 33 has detected the terminal point of polishing conventionally
[0004] Moreover, it sets to JP,5-226334,A. As shown in drawing 6 (a), after forming wiring 32 on the semiconductor substrate 31, as shown in drawing 6 (b) As the layer 34 harder than a next layer insulation layer, i.e., a silicon nitride film, is formed on the semiconductor substrate 31 more highly than wiring 32 and it is shown in drawing 6 (c) after this, the oxide film 33 which is a layer insulation layer is formed, and chemical mechanical polishing of this oxide film 33 is performed. If the polishing pad 35 of polishing equipment contacts a silicon nitride film 34 at this time as shown in drawing 6 (d), when a polishing speed becomes slower than the time of polishing of an oxide film 33, the terminal point of polishing will be detected.
[0005] Furthermore, in JP,4-357851,A, while a rotary table, a substrate electrode holder, etc. in chemical mechanical polishing equipment are made into electrode structure, an electric instrumentation system is prepared, and the terminal point of polishing is detected by measuring the dielectric layer thickness on a conductive substrate in capacity.
[0006]
[Problem(s) to be Solved by the Invention] However, like the conventional example explained in drawing 5 , some which detect the terminal point of polishing of an oxide film 33 by polishing time had the fault for which conditioning is needed, whenever the membraneous qualities of the oxide film 33 to grind differed.
[0007] Moreover, like the JP,5-226334,A publication explained in drawing 6 , processes, such as membrane formation, a photolithography, etching, and ashing, were needed, and some which form the cylinder of the silicon nitride film 34 for a terminal-point detection had the fault that the number of processes increased sharply.
[0008] Furthermore, like the JP,4-357851,A publication mentioned above, since what measures the dielectric layer thickness on a conductive substrate in capacity prepared the electric instrumentation system while it made electrode structure a rotary table, a substrate electrode holder, etc. in polishing equipment, it had the problem that the polishing equipment of special structure was needed.
[0009] Then, this invention aims at offering the technique of detecting the terminal point of chemical mechanical polishing simply and correctly, without moreover needing the polishing equipment of special structure, and chemical mechanical polishing equipment, without making the number of processes increase sharply irrespective of the membraneous quality of the layer which should be ground.
[0010]
[Means for Solving the Problem] In order to solve the above-mentioned technical probrem, the ion for a terminal-point detection which is the technique of detecting the terminal point at the time of this invention grinding chemically mechanically the layer formed on the semiconductor substrate, and serves as an impurity about the membrane component into the aforementioned layer beforehand is poured in, and the terminal point of polishing is detected by measuring the concentration of the aforementioned ion

which ****s in polishing liquid at the time of polishing of the aforementioned layer using polishing liquid.
[0011] Moreover, it is the equipment which grinds chemically mechanically the layer formed on the aforementioned semiconductor substrate, and is equipped with an ion-concentration measurement means measure the concentration of the aforementioned ion which ****s in polishing liquid, at the time of polishing of the aforementioned layer with which the ion for a terminal-point detection was poured in beforehand, contacting this invention to the polishing pad in which the front face of the semiconductor substrate held at the substrate electrode holder was established on the rotary table, and supplying polishing liquid.
[0012]
[Function] Since the ion for a terminal-point detection is beforehand poured in into the layer which should be ground according to this invention constituted as mentioned above, when polishing of the layer using polishing liquid reaches the range of ion, in polishing liquid, with the component of the ground layer, ion will be contained and it will come out. By measuring the concentration of the ion in this polishing liquid, the terminal point of polishing is correctly [very simply and] detectable.
[0013] By this, it is enabled to detect by spot observation, without basing the terminal point of polishing on membraneous quality. Moreover, since processes, such as membrane formation like [in the case of forming the cylinder of the silicon nitride film for a terminal-point detection], a photolithography, etching, and ashing, are unnecessary, the number of processes does not increase sharply. Furthermore, since the electrical property of a semiconductor substrate etc. is not measured, the mainframe of polishing equipment does not need special structure at all. And since the ion distribution depth in a layer is changeable by controlling the energy at the time of pouring in ion, it is possible to set up a terminal position freely.
[0014]
[Example] Hereafter, the example of the terminal-point method of detection and chemical mechanical polishing equipment in the chemical mechanical grinding method by this invention is explained with reference to drawing 1 - view 4 .
[0015] First, as shown in drawing 2 (a), after forming wiring 12 on the semiconductor substrate 11, as shown in drawing 2 (b), an oxide film 13 is formed as a layer insulation layer for insulating wiring 12 and the wiring further formed on it. Next, as shown in drawing 2 (c), the ion for a terminal-point detection 14 which serves as an impurity about an oxide film 13, for example, phosphorus ion, is driven in into an oxide film 13. At this time, the depth into which ion 14 is driven is controllable by the energy at the time of placing.
[0016] Next, an oxide film 13 is ground chemically mechanically, setting the semiconductor substrate 11 to the chemical mechanical polishing equipment 15 so that the oxide film 13 may become downward, and supplying polishing liquid 16, as shown in drawing 1 (a).
[0017] If polishing of an oxide film 13 advances and it arrives at the injection region of ion 14 as shown in drawing 1 (b), in polishing liquid 16, with the component of the ground oxide film 13, ion 14 will be contained and it will come out. Then, the concentration of the ion 14 in polishing liquid 16 can be measured by the ion concentration measuring device 19, and this can detect the terminal point of polishing very simply and correctly. In addition, the ion concentration measuring device 19 in this example is constituted by the resistance heater 17 which the polishing liquid 16 under polishing is heated [heater] and evaporates it, and the mass spectrograph 18 which measures the concentration of the ion 14 in the evaporated ambient atmosphere.
[0018] Being shown in drawing 3 expresses the plan of the chemical mechanical polishing equipment 15. The resistance heater 17 is formed in the periphery section of the chemical mechanical polishing equipment 15. In order to form the resistance heater 17 in the periphery section, it is enabled to be stabilized and to evaporate polishing liquid 16. Since polishing liquid 16 is evaporated on the chemical mechanical polishing equipment 15 by heating of the resistance heater 17 and this ion that evaporated can be measured with the direct mass spectrograph 18, a time lag can measure few. Therefore, exact polishing can be performed. In addition, as shown in drawing 3 , the resistance heater 17 may be formed locally, and by the case, you may prepare in the whole chemical mechanical polishing equipment 15.
[0019] When performing chemical mechanical polishing using the terminal-point method of detection of this example mentioned above, the mainframe of the polishing equipment 15 does not need special structure at all. That is, since what is necessary is just to measure the polishing liquid 16 supplied for polishing by the ion concentration measuring device 19 in connection with advance of polishing, you may form this ion concentration measuring device 19 in the mainframe and another field of the polishing equipment 15. Moreover, since injection of the ion for a terminal-point detection 14 can use the ion implantation equipment used abundantly by the manufacturing process of a semiconductor device, it faces applying the technique of this example and a special equipment facility is unnecessary.
[0020] In addition, although the mainframe of the polishing equipment 15 does not need special structure at all as mentioned above, the suitable example of the polishing equipment 15 equipped with the ion concentration measuring device 19 is explained with reference to drawing 4 below.
[0021] That is, the polishing equipment 15 has a rotary table 21 and the substrate electrode holder 22, and it is equipped with the polishing pad 23 on the rotary table 21. It is made to hold so that an oxide film 13 may become the substrate electrode holder 22 downward about the semiconductor substrate 11, and the front face of an oxide film 13 is stuck to the polishing pad 23. And while a rotary table 21 is rotated focusing on shaft 21a, while substrate electrode-holder 22 the very thing also makes it rotate focusing on shaft 22a and supplies polishing liquid 16 on the polishing pad 23 by the supply nozzle 24, an oxide film 13 is ground by collaboration operation with polishing liquid 16 and the polishing pad 23.
[0022] In the above-mentioned polishing equipment 15, new polishing liquid 16 is supplied on the polishing pad 23 near the center of a rotary table 21, and the polishing liquid 16 which contains the component of an oxide film 13 in connection with

advance of polishing flows to the periphery section with the rotation centrifugal force of a rotary table 21. Then, as shown in drawing 4 (a), a container 25 is installed underneath the periphery section of a rotary table 21, the polishing liquid 16 which flows and falls from a rotary table 21 is extracted with a container 25, and this polishing liquid 16 is measured by the ion concentration measuring device 19. In this example, since the falling polishing liquid 16 is extracted, the structure for extraction becomes easy. Or as shown in drawing 4 (b), the suction nozzle 26 may be installed on the polishing pad 23 near the outside of the substrate electrode holder 22, the polishing liquid 16 on the polishing pad 23 may be extracted by the suction nozzle 26, and this polishing liquid 16 may be measured by the ion concentration measuring device 19. Especially in this example, since the polishing liquid 16 immediately after acting on polishing can be measured, terminal-point detection precision can be raised more.

[0023] As mentioned above, although the example of this invention was explained, based on the technical thought of this invention, various kinds of effective change and applications are possible for this invention, without being limited to the above-mentioned example. For example, the ion for a terminal-point detection which layers of various kinds [each class] other than the oxide film as an insulator layer during a wiring are sufficient as the layer to grind, and it pours in into a layer can also apply various kinds of ion according to the layer. Moreover, an ion concentration measurement means can also adopt various kinds of measuring devices.

[0024]

[Effect of the Invention] By measuring the concentration of the ion which drives in the ion for a terminal-point detection beforehand into the layer which should be ground, and ****s in polishing liquid in connection with polishing of the layer according to this invention, as explained above Further a terminal position in the status that it set up freely, without moreover needing the polishing equipment of special structure, without making the number of processes increase sharply irrespective of the membraneous quality of the layer to grind It is enabled to detect the terminal point of chemical mechanical polishing very simply and correctly, and promotion of the high integration in a semiconductor device and enhancement in a reliability can be aimed at.

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Field

[Field of the Invention] In the manufacturing process of a semiconductor device, in case this invention grinds chemically mechanically the layer formed on the semiconductor substrate, it relates to the method of detecting the terminal point of the polishing, and suitable chemical mechanical polishing equipment to use this technique

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Technique

[Description of the Prior Art] In the manufacturing process of a semiconductor device, various modalities, such as a front face of a wrap insulator layer, and the flattening to the front face of the membrane layer of a position are often performed in the wiring formed, for example on the semiconductor substrate, and there is chemical mechanical polishing as one of these flattening techniques. It grinds chemically mechanically the layer formed on the semiconductor substrate by collaboration operation with polishing liquid and a polishing pad, contacting this chemical mechanical polishing to the polishing pad in which the front face of the semiconductor substrate held at the substrate electrode holder was established on the rotary table, and supplying polishing liquid. And in this chemical mechanical polishing, in order to form a flat front face by the predetermined thickness, without removing the layer of a lower layer of the layer which should be ground, it is very important to detect the terminal point of polishing certainly.

[0003] For example, as shown in drawing 5 (b), the oxide film 33 which is a layer insulation layer is formed, and as shown in drawing 5 (a), after forming wiring 32 on the semiconductor substrate 31, as shown in drawing 5 (c) after this, chemical mechanical polishing of an oxide film 33 is performed. Generally at this time, the polishing time from polishing start of an oxide film 33 has detected the terminal point of polishing conventionally

[0004] Moreover, it sets to JP,5-226334,A. As shown in drawing 6 (a), after forming wiring 32 on the semiconductor substrate 31, as shown in drawing 6 (b) As the layer 34 harder than a next layer insulation layer, i.e., a silicon nitride film, is formed on the semiconductor substrate 31 more highly than wiring 32 and it is shown in drawing 6 (c) after this, the oxide film 33 which is a layer insulation layer is formed, and chemical mechanical polishing of this oxide film 33 is performed. If the polishing pad 35 of polishing equipment contacts a silicon nitride film 34 at this time as shown in drawing 6 (d), when a polishing speed becomes slower than the time of polishing of an oxide film 33, the terminal point of polishing will be detected.

[0005] Furthermore, in JP,4-357851,A, while a rotary table, a substrate electrode holder, etc. in chemical mechanical polishing equipment are made into electrode structure, an electric instrumentation system is prepared, and the terminal point of polishing is detected by measuring the dielectric layer thickness on a conductive substrate in capacity.

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Effect

[Effect of the Invention] By measuring the concentration of the ion which drives in the ion for a terminal-point detection beforehand into the layer which should be ground, and ****s in polishing liquid in connection with polishing of the layer according to this invention, as explained above Further a terminal position in the status that it set up freely, without moreover needing the polishing equipment of special structure, without making the number of processes increase sharply irrespective of the membraneous quality of the layer to grind It is enabled to detect the terminal point of chemical mechanical polishing very simply and correctly, and promotion of the high integration in a semiconductor device and enhancement in a reliability can be aimed at

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, like the conventional example explained in drawing 5 , some which detect the terminal point of polishing of an oxide film 33 by polishing time had the fault for which conditioning is needed, whenever the membraneous qualities of the oxide film 33 to grind differed.

[0007] Moreover, like the JP,5-226334,A publication explained in drawing 6 , processes, such as membrane formation, a photolithography, etching, and ashing, were needed, and some which form the cylinder of the silicon nitride film 34 for a terminal-point detection had the fault that the number of processes increased sharply.

[0008] Furthermore, like the JP,4-357851,A publication mentioned above, since what measures the dielectric layer thickness on a conductive substrate in capacity prepared the electric instrumentation system while it made electrode structure a rotary table, a substrate electrode holder, etc. in polishing equipment, it had the problem that the polishing equipment of special structure was needed.

[0009] Then, this invention aims at offering the technique of detecting the terminal point of chemical mechanical polishing simply and correctly, without moreover needing the polishing equipment of special structure, and chemical mechanical polishing equipment, without making the number of processes increase sharply irrespective of the membraneous quality of the layer which should be ground.

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MEANS

[Means for Solving the Problem] In order to solve the above-mentioned technical probrem, the ion for a terminal-point detection which is the technique of detecting the terminal point at the time of this invention grinding chemically mechanically the layer formed on the semiconductor substrate, and serves as an impurity about the membrane component into the aforementioned layer beforehand is poured in, and the terminal point of polishing is detected by measuring the concentration of the aforementioned ion which ****s in polishing liquid at the time of polishing of the aforementioned layer using polishing liquid.
[0011] Moreover, it is the equipment which grinds chemically mechanically the layer formed on the aforementioned semiconductor substrate, and is equipped with an ion-concentration measurement means measure the concentration of the aforementioned ion which ****s in polishing liquid, at the time of polishing of the aforementioned layer with which the ion for a terminal-point detection was poured in beforehand, contacting this invention to the polishing pad in which the front face of the semiconductor substrate held at the substrate electrode holder was established on the rotary table, and supplying polishing liquid.

[Translation done.]

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OPERATION

[Function] Since the ion for a terminal-point detection is beforehand poured in into the layer which should be ground according to this invention constituted as mentioned above, when polishing of the layer using polishing liquid reaches the range of ion, in polishing liquid, with the component of the ground layer, ion will be contained and it will come out. By measuring the concentration of the ion in this polishing liquid, the terminal point of polishing is correctly [very simply and] detectable.
[0013] By this, it is enabled to detect by spot observation, without basing the terminal point of polishing on membraneous quality. Moreover, since processes, such as membrane formation like [in the case of forming the cylinder of the silicon nitride film for a terminal-point detection], a photolithography, etching, and ashing, are unnecessary, the number of processes does not increase sharply. Furthermore, since the electrical property of a semiconductor substrate etc. is not measured, the mainframe of polishing equipment does not need special structure at all. And since the ion distribution depth in a layer is changeable by controlling the energy at the time of pouring in ion, it is possible to set up a terminal position freely.

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EXAMPLE

[Example] Hereafter, the example of the terminal-point method of detection and chemical mechanical polishing equipment in the chemical mechanical grinding method by this invention is explained with reference to drawing 1 - view 4 .

[0015] First, as shown in drawing 2 (a), after forming wiring 12 on the semiconductor substrate 11, as shown in drawing 2 (b), an oxide film 13 is formed as a layer insulation layer for insulating wiring 12 and the wiring further formed on it. Next, as shown in drawing 2 (c), the ion for a terminal-point detection 14 which serves as an impurity about an oxide film 13, for example, phosphorus ion, is driven in into an oxide film 13. At this time, the depth into which ion 14 is driven is controllable by the energy at the time of placing.

[0016] Next, an oxide film 13 is ground chemically mechanically, setting the semiconductor substrate 11 to the chemical mechanical polishing equipment 15 so that the oxide film 13 may become downward, and supplying polishing liquid 16, as shown in drawing 1 (a).

[0017] If polishing of an oxide film 13 advances and it arrives at the injection region of ion 14 as shown in drawing 1 (b), in polishing liquid 16, with the component of the ground oxide film 13, ion 14 will be contained and it will come out. Then, the concentration of the ion 14 in polishing liquid 16 can be measured by the ion concentration measuring device 19, and this can detect the terminal point of polishing very simply and correctly. In addition, the ion concentration measuring device 19 in this example is constituted by the resistance heater 17 which the polishing liquid 16 under polishing is heated [heater] and evaporates it, and the mass spectrograph 18 which measures the concentration of the ion 14 in the evaporated ambient atmosphere.

[0018] Being shown in drawing 3 expresses the plan of the chemical mechanical polishing equipment 15. The resistance heater 17 is formed in the periphery section of the chemical mechanical polishing equipment 15. In order to form the resistance heater 17 in the periphery section, it is enabled to be stabilized and to evaporate polishing liquid 16 Since polishing liquid 16 is evaporated on the chemical mechanical polishing equipment 15 by heating of the resistance heater 17 and this ion that evaporated can be measured with the direct mass spectrograph 18, a time lag can measure few. Therefore, exact polishing can be performed. In addition, as shown in drawing 3 , the resistance heater 17 may be formed locally, and by the case, you may prepare in the whole chemical mechanical polishing equipment 15

[0019] When performing chemical mechanical polishing using the terminal-point method of detection of this example mentioned above, the mainframe of the polishing equipment 15 does not need special structure at all. That is, since what is necessary is just to measure the polishing liquid 16 supplied for polishing by the ion concentration measuring device 19 in connection with advance of polishing, you may form this ion concentration measuring device 19 in the mainframe and another field of the polishing equipment 15. Moreover, since injection of the ion for a terminal-point detection 14 can use the ion implantation equipment used abundantly by the manufacturing process of a semiconductor device, it faces applying the technique of this example and a special equipment facility is unnecessary.

[0020] In addition, although the mainframe of the polishing equipment 15 does not need special structure at all as mentioned above, the suitable example of the polishing equipment 15 equipped with the ion concentration measuring device 19 is explained with reference to drawing below.

[0021] That is, the polishing equipment 15 has a rotary table 21 and the substrate electrode holder 22, and it is equipped with the polishing pad 23 on the rotary table 21. It is made to hold so that an oxide film 13 may become the substrate electrode holder 22 downward about the semiconductor substrate 11, and the front face of an oxide film 13 is stuck to the polishing pad 23. And while a rotary table 21 is rotated focusing on shaft 21a, while substrate electrode-holder 22 the very thing also makes it rotate focusing on shaft 22a and supplies polishing liquid 16 on the polishing pad 23 by the supply nozzle 24, an oxide film 13 is ground by collaboration operation of polishing liquid 16 and the polishing pad 23.

[0022] In the above-mentioned polishing equipment 15, new polishing liquid 16 is supplied on the polishing pad 23 near the center of a rotary table 21, and the polishing liquid 16 which contains the component of an oxide film 13 in connection with advance of polishing flows to the periphery section with the rotation centrifugal force of a rotary table 21. Then, as shown in drawing 4 (a), a container 25 is installed underneath the periphery section of a rotary table 21, the polishing liquid 16 which flows and falls from a rotary table 21 is extracted with a container 25, and this polishing liquid 16 is measured by the ion concentration measuring device 19. In this example, since the falling polishing liquid 16 is extracted, the structure for extraction becomes easy. Or as shown in drawing 4 (b), the suction nozzle 26 may be installed on the polishing pad 23 near the outside of the substrate electrode holder 22, the polishing liquid 16 on the polishing pad 23 may be extracted by the suction nozzle 26, and this polishing

liquid 16 may be measured by the ion concentration measuring device 19. Especially in this example, since the polishing liquid 16 immediately after acting on polishing can be measured, terminal-point detection precision can be raised more.

[0023] As mentioned above, although the example of this invention was explained, based on the technical thought of this invention, various kinds of effective change and applications are possible for this invention, without being limited to the above-mentioned example. For example, the ion for a terminal-point detection which layers of various kinds [each class] other than the oxide film as an insulator layer during a wiring are sufficient as the layer to grind, and it pours in into a layer can also apply various kinds of ion according to the layer. Moreover, an ion concentration measurement means can also adopt various kinds of measuring device.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the outline cross section of the semiconductor device explaining the terminal-point method of detection and polishing equipment in an example of this invention, and polishing equipment.
[Drawing 2] It is the outline cross section of the semiconductor device ground in the above-mentioned example.
[Drawing 3] It is the outline plan of the polishing equipment in the above-mentioned example.
[Drawing 4] It is the outline cross section of the polishing equipment in the suitable example of this invention.
[Drawing 5] It is the outline cross section of the semiconductor device explaining the conventional general terminal-point method of detection.
[Drawing 6] It is the outline cross section of the semiconductor device explaining the terminal-point method of detection using the layer for the conventional terminal-point detection.
[Description of Notations]
11 Semiconductor Substrate
12 Wiring
13 Oxide Film Which is Lower Insulation Layer
14 Ion for Terminal-Point Detection
15 Chemical Mechanical Polishing Equipment
16 Polishing Liquid
17 Resistance Heater
18 Mass Spectrograph
19 Ion Concentration Measuring Device
21 Rotary Table
22 Substrate Electrode Holder
23 Polishing Pad
24 Nozzle for Polishing Liquid Supply
25 Container for Polishing Liquid Extraction
26 Nozzle for Polishing Liquid Suction

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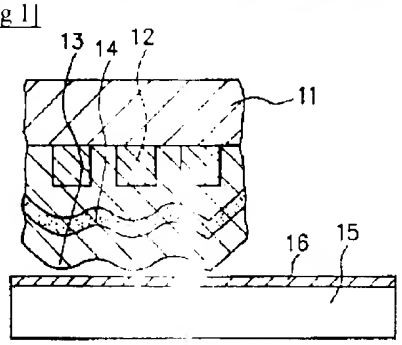
DRAWINGS

[Drawing 1]

(a)



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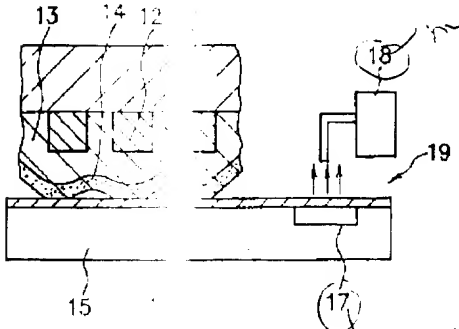
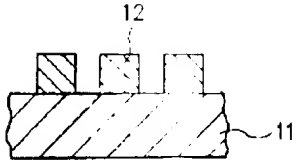


[Drawing 2]

(a)



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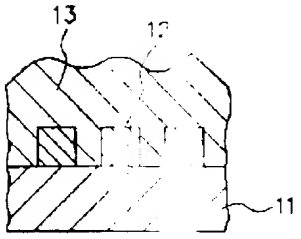

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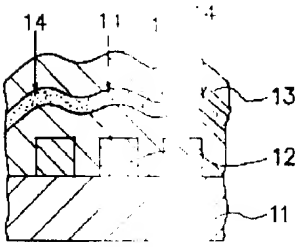

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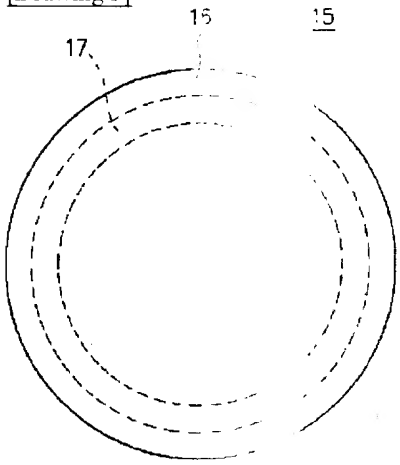
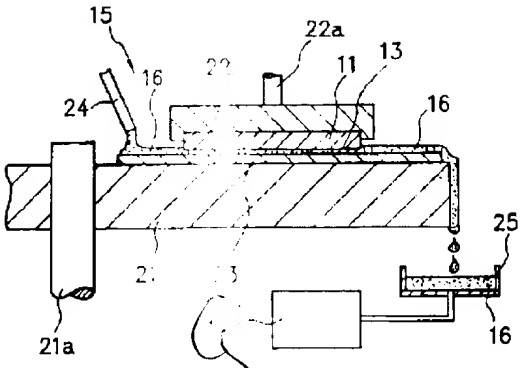


[Drawing 4]

(a)



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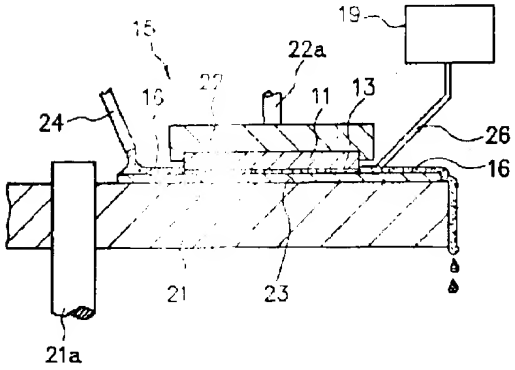
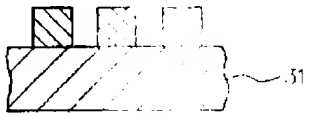


[Drawing 5]

(a)



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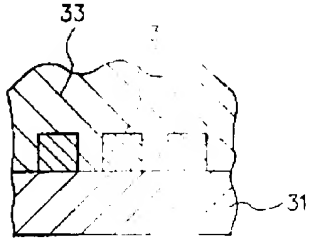
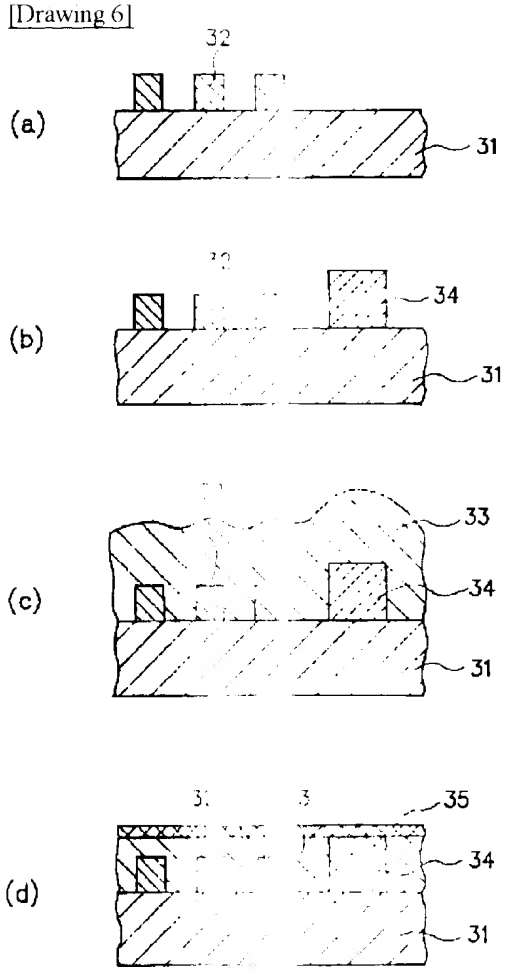


(c)

[Drawing 6]



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